

# PATENT SPECIFICATION

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## (54) TENSIONING AND SEVERING TOOLS

(71) We, DENNISON MANUFACTURING CO. LIMITED, a Company registered under the laws of England, of Colonial Way, Watford, Hertfordshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to a tensioning and severing tool and more particularly but not exclusively to a tool for the installation of fasteners such as cable ties.

According to the present invention, a tensioning and severing tool comprises a gripper for an article to be tensioned, a drive member, a transmission between the drive member and the gripper including a toggle linkage arranged so that the linkage is in compression during tensioning, a spring holding the linkage in an almost straight condition until a predetermined tensioning force is applied by the drive member through the toggle linkage to the gripper, and a sever mechanism operable by collapse of the toggle linkage to sever the article.

Preferably, the tool includes a housing and a slide member slidable in the housing, the gripper being mounted at one end of the slide member and one of the toggle links being pivoted to the other end of the slide member. The other toggle link may be pivoted to one end of a lever constituting the drive member, the other end of the lever being pivoted to the housing. Preferably, the spring applies a force through a bar which is connected to the knuckle joint of the toggle.

The invention may be carried into practice in various ways but one tensioning and severing tool embodying the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of the tool

being used in the installation of a cable tie;

Figure 2A is a perspective view of the tensioning and sever mechanisms in the installation tool of Figure 1;

Figure 2B is a schematic representation of the tensioning and severing mechanisms of Figure 2A during tensioning;

Figure 2C is a schematic representation of the tensioning and severing mechanism of Figure 2A during severing;

Figure 3A is a perspective view of a compression spring cage for the adjustment of tension applied by the tool;

Figure 3B is a perspective view of the interior of the cage of Figure 3A;

Figure 4A is a view of the installation tool of Figure 1 with portions broken away to show the placement of constituents pictured in Figures 2A to 3B;

Figure 4B is an end view of the tool of Figure 4A; and

Figure 4C is a top view of the tool of Figure 4A.

Turning to the drawings, there is shown a tensioning and severing tool 10 formed by split-cover housing 10h containing a tensioning assemblage 11 and a pivoted cut-off lever 12, which is visible through a viewing aperture of a cutter guard 12g and mounts a cutter blade 12b.

As illustrated in Figure 1, the tool 10 can be used to complete the installation of an item such as a cable tie 20. The strap portion 21 of the tie 20 is wrapped around articles that are to be bundled, for example the individual wires W of a cable C. A free end 22 of the tie 20 is inserted through the head 23 of the strap into the mouth of the tool 10 between gripper constituents 11p and 11a of the tensioning assemblage 11.

When force F<sub>1</sub> is applied to a trigger 13 of the tool 10, it is transmitted through levers and linkages (not visible in Figure 1) to the tensioning assemblage 11, causing the assemblage to be drawn towards the rear of

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the gun. This frees a pivoted and spring-loaded pawl 11p which rotates against the portion 22 of the strap and grips it with respect to a stud 11a.

5 The initial rearward motion of the tensioning assemblage 11 caused by the force  $F_t$ , tightens the portion 21 of the strap around the wires W of the cable C, with the head 23 of the cable tie 20 in close abutment with the tool 10. Further movement of the tensioning assemblage 11 increases the tension applied to the gripped portion 22 of the tie 20 until a predetermined tension level is reached. At that point, as explained below, the force transmitted to the tensioning assemblage 11 from the trigger 13 causes a collapse of the intervening linkage which acts upon the cutoff lever 12 and pivots it upwardly, bringing the blade 12b into sever position with respect to the gripped end portion 22 of the cable tie 20.

10 In the operation of a typical tensioning and severing tool previously available, the sever action produces a significant shock impact. However, this impact is significantly reduced to in the tool being described because of the particular way in which the cutoff lever 12 is operated, as explained in conjunction with Figures 2A to 2C.

15 A perspective view showing the relationship between the tensioning assemblage 11 and the cutoff lever 12 is given in Figure 2A. The tensioning assemblage 11 is maintained in a normally forward position in the tool 10 by a compression spring 11c. The tensioning assemblage is connected to the trigger 13 through a set of actuator linkages including toggle linkages 14 and an internal actuator lever 15.

20 When the trigger force  $F_t$  is applied, it is transmitted through a trigger link 13t to the actuator lever 15 which is pivotally mounted within the handle 16 of the tool 10. The upper portion of the actuator lever 15 is pivotally connected to the toggle linkages 14, which are, in turn, pivotally connected to the bar 11b of the tensioning assemblage 11. To maintain the toggle linkages 14 in position to transmit the trigger force  $F_t$ , a countervailing force  $F_c$  is applied to the midpoint 14m of the toggle through a toggle arm 14a. The toggle is never completely straight; there is always a slight angular inclination, in the rest position, towards the force  $F_c$ . When the tensioning force applied from the trigger 13 exceeds the countervailing force  $F_c$ , the toggle collapses by pivoting with respect to both the actuator lever 15 and the tensioning bar 11b and engages a cam surface 12c of the cutoff lever 12. Since the operation of the cutoff lever takes place while the actuator lever is moving to the rear, there is, in effect, a cushioned impact of the collapsed toggle linkages 14 against the cutoff lever 12. It is believed that this

25 cushioning limits the shock loading that is produced when the strap 22 is severed.

30 In addition, an ejector spring 17, in the form of a leaf 17f with a curved end portion 17c extending into the mouth of the tool, is included to reduce any tendency for the severed end of the strap to be propelled toward the user.

35 As the tensioning bar 11b is drawn towards the rear of the gun 10, the curved portion 17c of the ejector spring 17 tends to be flattened against the adjoining housing wall. When the pawl 11p reaches a cam surface 11c (shown in Figures 1 and 2A), with the strap 22 under tension, the cam acts upon the pawl and partially releases it. In addition, as noted in Figure 1, the housing 10h has a shield 10s that extends at the top of the gun to the vicinity of the ejector spring 17. Consequently when the strap is under tension, with the pawl 11p partially released and the spring 17 partially deflected, and the cutter blade 12b is operated to sever the strap, the severed portion tends to be propelled laterally out of the housing, instead of towards the user. The desired lateral propulsion is promoted by contributions from the shield 10s, the partial pawl release pivoted by the cam 11c and the ejector spring 17.

40 A schematic representation of the tensioning and sever operation is illustrated in Figures 2B and 2C. Initially as shown in Figure 2B the individual links of the toggle assemblage 14 are almost in alignment but with a slight inclination downwards. For simplicity the toggle assemblage 14 in Figure 2B is shown formed by the first line 14-1 that is pivotally connected to the tensioning bar 11b and a second link 14-2 that is pivotally connected to the actuator lever 15. This actuator and sever links 14-1 and 14-2 are in turn pivotally joined. It is at this point of joinder 14m that the countervailing force  $F_c$  is applied. To keep the countervailing force from driving the links 14-1 and 14-2 of the toggle assembly out of alignment, the tensioning bar 11b includes an integral stop 11t shown in Figure 2B. A possible alternative is shown in Figure 4A where the upward motion of the linkages is limited by a slot 11s in the draw bar 11b. The various ways of applying the countervailing force  $F_c$  to the toggle assemblage 14 are discussed below.

45 When the tension applied to the strap by the bar 11b exceeds the value of the countervailing force  $F_c$  applied at the pivot centre 14m of the toggle assemblage 14, the toggle collapses as shown in Figure 2C. This collapse brings the bearing surface 14b of the toggle into engagement with the cam surface 12c at the rear of the cutoff lever 12. Since the toggle assemblage 14 is formed by pivotally connected members, the force transmitted to the cutoff lever is composed

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of both horizontal and vertical components, by which a cushioned impact is applied to the cutoff lever 12, instead of a direct impact, so that impact shock loading is avoided.

In addition, as is evident from Figure 2B, the use of the trigger 13 in conjunction with the actuator lever 15 provides a mechanical advantage so that the amount of operator force applied to the toggle is considerably less than that needed with conventional installation tools. The use of the actuator lever 15 also permits the desired tensioning force to be applied by movement over a relatively small arc of operation of the trigger 13.

The desired countervailing force  $F_c$  is provided by a compression spring 32s in a cage 30 shown in Figures 3A and 3B. As indicated in Figure 3A the end of the toggle linkage 14a is connected by a pivot pin 31p to the lower end of a cover part 31 of the cage 30, which is slideably movable with respect to a housing part 32 of the cage within which the spring 32s is located. One end of the spring abuts the bottom wall of the housing while the top end abuts a lug 31p which projects from the upper end of the cover part 31 into the housing part 32. A possible alternative to the compression spring 32s and cage 30 is a tension spring one end of which is hooked to the end of the link 14a and the other end of which is hooked to the body of the tool near the top of the link 14a but such a spring tends to be mechanically unreliable.

To adjust the tension applied through the toggle arm 14a an adjusting member 32a is threaded into the bottom portion 32 of the cage 30 as shown in Figure 3B by rotation of a tension control knob 33. This moves the lower portion 32 of the cage 30 of Figure 3A upwardly with respect to the upper portion 31 and carries with it the indicator 32r that moves within a slot 31s of the cover portion 31 and simultaneously causes compression of the tension control spring 32s. This arrangement achieves precise control over tension and a high degree of mechanical stability.

A partial sectional view of the entire installation tool of Figure 1 is shown in Figures 4A to 4C to indicate the relative positioning of the internal constituents of the tool, as well as the interrelations among those constituents.

Thus in the tool 10 as shown in Figures 4A and 4B the toggle assemblage 14 is formed by four links (Figure 4C) 14-1 to 14-4. The link 14-1 is seated on a hub 11h of the tensioning bar 11b. The link 14-1 is in turn pivotally connected to the arm 14a that extends to the compression cage 30, the arm 14a is connected to the lever 15 by the link 14-2, as well as by the further link 14-3.

There is also pivotal connection between the hub 11h of the tensioning bar 11b and the arm 14a by the link 14-4. It is the latter link that limits the upward movement of the toggle assemblage due to the application of the compression force  $F_c$  through the arm 14a. This is because the fourth linkage 14-4 rides in the slot 11s of the tensioning bar 11b. Initially with the full compression force  $F_c$  applied to the arm 14a the individual links of the toggle assemblage are almost in alignment and the link 14-4 is seated in the upper part of the recess 11s. When the tension applied to the strap exceeds the countervailing force  $F_c$  the toggle assemblage collapses as described previously and the link 14-4 moves out of the slot 11s to contact the cam surface 12c and operate the sever lever 12.

Also indicated in Figures 4A and 4B is the placement of the cam 11c that provides partial release of the pawl 11p before sever.

Details of the compression cage 30 are illustrated in Figures 4A and 4C.

Attention is directed to our Patent Application No. 79.29174 (Serial No 1577958) which has been divided from this application and which claims a tensioning and severing tool comprising a housing, a gripper slidable in the housing between a forward position and a rearward position to tension an elongate article gripped by the gripper, a sever mechanism operable to sever the article at a location spaced forwardly of the said rearward position, and an ejector spring located between the forward and rearward positions and operative on a portion of the article drawn by the gripper past the forward position to the rearward position to bias the said portion in a direction generally perpendicular to the length of the said portion and out of the tool.

#### WHAT WE CLAIM IS:-

1. A tensioning and severing tool comprising a gripper for an article to be tensioned, a drive member, a transmission between the drive member and the gripper including a toggle linkage arranged so that the linkage is in compression during tensioning, a spring holding the linkage in an almost straight condition until a predetermined tensioning force is applied by the drive member through the toggle linkage to the gripper, and a sever mechanism operable by collapse of the toggle linkage to sever the article.

2. A tool as claimed in Claim 1 which includes a housing and a slide member slidable in the housing, the gripper being mounted at one end of the slide member and one of the toggle links being pivoted to the other end of the slide member.

3. A tool as claimed in Claim 2 in which the other toggle link is pivoted to one end of a lever constituting the drive member, the

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other end of the lever being pivoted to the housing.

4. A tool as claimed in Claim 2 or Claim 3 in which the spring applies a force through a bar which is connected to the knuckle joint of the toggle.

5. A tool as claimed in Claim 4 in which the spring is a compression spring which exerts a force between the bar and the housing.

10. 6. A tool as claimed in Claim 5 in which one end of the spring is attached to the housing by a screw by which the compression force exerted by the spring on the bar is adjustable.

15. 7. A tool as claimed in Claim 5 in which the other end of the compression spring is attached to a cage member extending alongside the spring, the bar being attached to the cage member at a point adjacent the said one end of the spring.

20. 8. A tool as claimed in any of Claims 2 to 7 in which the sever mechanism comprises a cutter bar pivoted on the housing and extending generally parallel with the slide member, a blade carried by the cutter bar adjacent the gripper, and an abutment surface carried by the cutter bar in a position to be engaged by a part of the toggle linkage during its collapse to move the blade to a sever position.

25. 9. A tensioning and severing tool substantially as described herein with reference to the accompanying drawings.

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Chartered Patent Agents.  
Agents for the Applicants.

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1577957 COMPLETE SPECIFICATION

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the Original on a reduced scale  
Sheet 1

FIG. 1.

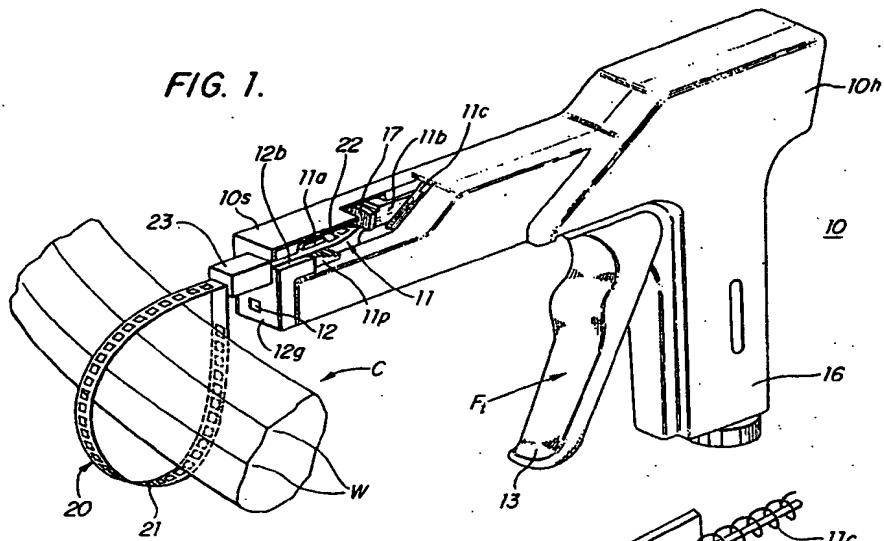
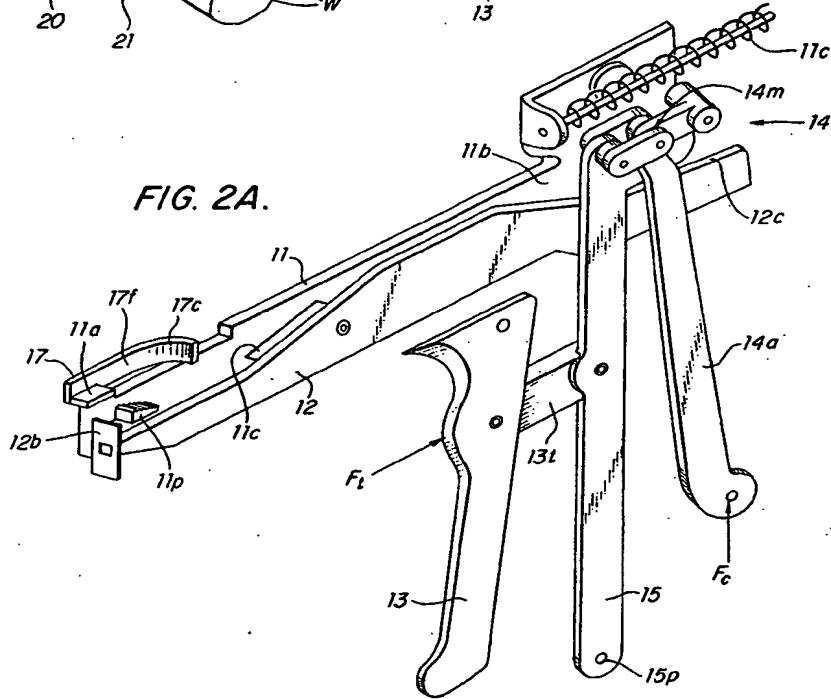


FIG. 2A.



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## COMPLETE SPECIFICATION

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Sheet 2

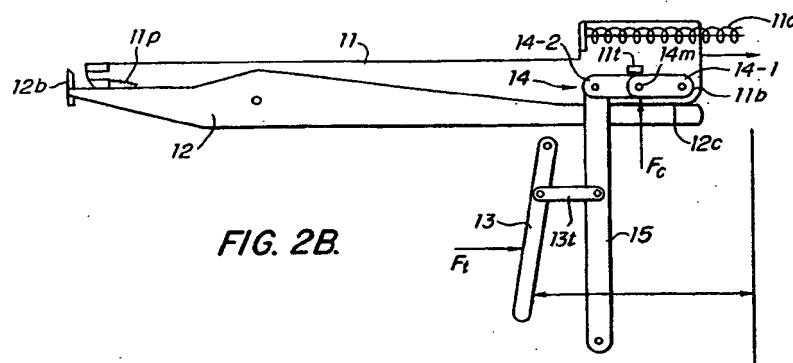


FIG. 2B.

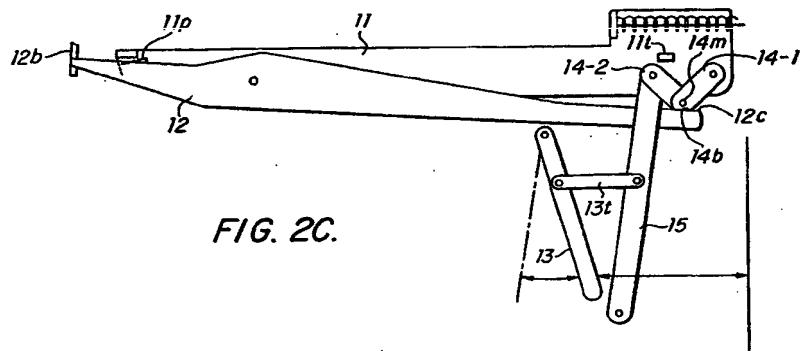


FIG. 2C.

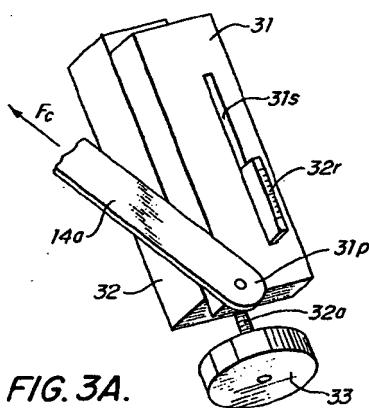


FIG. 3A.

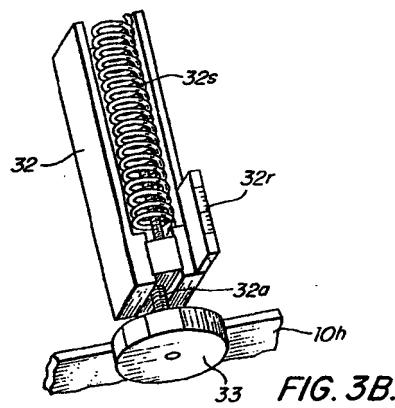


FIG. 3B.

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Sheet 3

